NATIONAL PARK SERVICE
CHANNEL ISLANDS NATIONAL PARK

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MARINE DEBRIS MONITORING PROGRAM
1993 ANNUAL REPORT

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ABSTRACT

Results are presented from three quarterly surveys conducted during 1992-1993 (year five of a five year program) at six study beaches on Santa Rosa and San Miguel Islands within Channel Islands National Park (CHIS). This year, the fall (December) surveys were not conducted on the four Santa Rosa Island beaches because of a series of heavy storms which prevented island travel. An average of 821 items/km was recorded, 95% consisting of plastic.

As in previous years, foam fragments were again the single most abundant item. The number of foam fragments declined again this year, though this may, in part, be affected by the missing surveys. Glass bottles were the most abundant non-plastic category. Quantities of plastic debris were greatest on the winter (March/April) surveys.

The 10 most abundant plastics in rank order were foam fragments, hard plastic fragments, bottles < 1 gallon, caps and lids, straws, bags < 1 m^2, oil containers, food containers, toys and rope < 1 m. Plastic objects that could be ingested by marine wildlife were less abundant than in past years because of the decline in foam fragments. Debris considered to be an entanglement hazard to wildlife remained at the same level as last year.

Debris from commercial and recreational fishing, and litter from boaters (both pleasure and commercial) are other

major sources of marine debris on the beaches of the Channel Islands. Debris also originated on the mainland, presumably washed down rivers and storm drains and deposited during the winter storms.

INTRODUCTION

Marine debris has become an issue of national concern in recent years. Plastic debris is of greatest concern because of its persistence in the environment and the hazards it poses to wildlife that may ingest it or become entangled in it. Marine debris also presents health and safety hazards and diminishes the aesthetic value of our beaches.

In order to establish a scientific data base about the abundance, composition, and accumulation rates of human-generated marine debris found on continental United States beaches, the National Park Marine Debris Monitoring Program was initiated in 1989. This five-year research effort, jointly funded by the National Park Service (NPS) and the National Marine Fisheries Service (NMFS), is monitoring the marine debris accumulation in eight National Parks located along the Pacific, Gulf, and Atlantic Coasts. Cole et al. (1990), Manski et al. (1991), and Cole et al. (1992) describe the results from the first three years of this national monitoring program.

Channel Islands National Park (CHIS) is one of the 10

parks in this program. Richards and Dugan (1991), Richards (1991, 1992, 1993) describe the results from CHIS during the first four years of monitoring. This report summarizes the results from year 5 of monitoring marine debris at CHIS.

STUDY AREA

Channel Islands National Park consists of five islands and surrounding marine ecosystems off the southern California coast. The park boundary includes five of the eight California Channel Islands and the submerged lands and waters within 1.8 km (1 nm) of each island. The islands range in size from 260 ha Santa Barbara Island to 25,100 ha Santa Cruz. The total area of the park (100,000 ha) is divided nearly equally between submerged lands and islands. The park is surrounded by the Channel Islands National Marine Sanctuary and is an International Man in the Biosphere Reserve. The islands harbor the only remaining relatively pristine coastline in southern California and are recognized for the rich abundance of wildlife that concentrates around the islands to breed.

The two islands in this study, Santa Rosa (21,450 ha) and San Miguel (4,047 ha) have a mix of sandy beaches and rocky shoreline. Santa Rosa and San Miguel Islands are the two western-most islands in the chain. Santa Barbara and Anacapa Islands are small volcanic islands with few sandy beaches. Santa Cruz Island has long stretches of sandy beach, but was

privately owned an inaccessible when this project started.

Prevailing winds throughout most of the year are from the northwest, hitting San Miguel and western Santa Rosa Island with full force from the open sea. Major storms often bring large southerly swells which impact the south facing beaches. Northeasterly "Santa Ana" winds occasionally occur in the fall and winter, generally creating calm conditions at Santa Rosa and San Miguel Islands.

The Santa Barbara Channel which separates the islands from the mainland coast is a major shipping route for vessels to and from the ports of San Pedro, Long Beach, and Los Angeles. The southbound shipping lane comes within a few km of the northern islands.

The Santa Maria Basin, which lies just north of Point Conception, and the Santa Barbara Channel have extensive oil and gas development. Offshore oil rigs are present throughout the Channel and Basin. Several storage and refinery facilities are located in the area and are regularly serviced by tankers.

Substantial recreational and commercial fishing fleets operate out of Ventura and Santa Barbara harbors, primarily working within the park boundary. Various trawlers, gillnetters, and purse seine boats ply the channel and island waters for rockfish, shark, squid, halibut, and other ground fish. Commercial divers collect sea urchins and abalone near

shore around the islands. As many as 65 fishing vessels have been observed around the west end of Santa Rosa Island on one day (Pers. obs., Dec. 1991).

There is extensive military activity in the area originating from the two Navy bases in Oxnard and Port Hueneme, and the facilities on San Clemente and San Nicolas Islands. Within the park boundary, a small Navy facility exists on Santa Cruz Island and air operations are conducted around Santa Rosa and San Miguel Islands.

STUDY BEACHES

Marine debris was monitored at five 1-km and one 600-m beaches (Figure 1). Public use of all six beaches was very low. Visitation to these beaches was primarily by NPS island personnel. Though chosen to avoid disturbing as little wildlife as possible, all of the beaches are important to wildlife. Each of the beaches are utilized at times by foraging shorebirds and resting harbor seals and elephant seals. Western snowy plovers, an threatened species, use the beaches for nesting in the spring and summer.

1. Simonton Cove: This beach faces directly into the prevailing northwest wind, with no protection from any points of land. The long, wide beach is backed by low dunes and a steep bluff. Average width of the beach was approximately 40

m. The flat beach consists of fine sand.

2. Cuyler Harbor: This sandy beach faces north and is somewhat protected by the island to the west. High dunes back the beach at both ends and a rocky cliff with a small jutting reef break up the beach in the middle. Most of the beach is less than 20 m wide. Cuyler Harbor is the primary anchorage on San Miguel Island with an average of two to three boats (maximum, approximately 20-30) anchoring there at night during most months. This is the only beach with much public access; however, visitation is still low.

3. Sandy Point: This beach faces northwest, though the winds may be tempered somewhat by Point Conception, approximately 60 km to the north. This beach undergoes severe erosion at times leaving several small rocky points along the 1 km transect. The width varies from 10 to 40 m at low tide. Large amounts of kelp wrack often pile up on the beach after storms. The narrow beach is backed by a low cliff.

4. Arlington Canyon: This flat, sandy beach is 600 m long with a northern exposure. The beach is backed by dunes and a small lagoon fed by a perennial stream near the west end of the beach. Except at the lagoon where it is generally wider, the width is only about 10 m. Kelp wrack occasionally piles

up very deep along the waters edge after storms. This beach was included in the surveys because it was the most accessible beach with this exposure.

5. Cluster Point: The only survey beach on the south side of the island, this beach faces southwest. The sand beach is generally flat and fairly broad (20-30 m wide). Low vegetated dunes back the western half of the beach forming a narrow toe along cliffs. The eastern half of the beach is backed by a low dune field and forms a small hook at the rocky point on the eastern margin.

6. Skunk Point: The east end of the survey transect is over 50 m wide as the point curves around to the south. The sand beach is very flat and often overwashed by high tides. Occasionally a shallow lagoon forms behind the berm. Low dunes behind the beach gradually climb a tall bluff. The northern exposure faces Beechers Bay, which is a popular anchorage and is the main access to the island and ranch operation.

METHODS

Beaches were surveyed in November 1992, March/April 1993, September 1993, and December 1993/January 1994. Surveys were not conducted on Santa Rosa Island (in December 1992)

because of heavy rains preventing island travel. Spring surveys (June) were not conducted to avoid disturbing nesting snowy plovers.

Two to five people conducted the surveys. The survey area for each beach included the intertidal zone between the water's edge and the seaward limit of terrestrial vegetation or base of the foredune or cliff. All human-generated debris visible from a walking height was collected and recorded on data sheets (see Manski et al. 1991 for debris definitions). Debris was generally sorted and tallied off-site. All debris was either removed or marked and noted so not to be counted on future surveys. Tar on the beach was noted as present or absent.

Items less than one-half their original size were considered fragments. Netting with less than five complete meshes were also regarded as fragments. Plastic cones from hagfish traps were reported as fishing gear fragments, but were noted as a special category also. Items attached as a functional unit were not counted separately (e.g., a rope connected to a float was classified as a float). Items were classified to their use (e.g., plastic bottles with a line attached were classified as other floats).

Plastic items considered as wildlife entanglement hazards included: rope ≥1 m, trawl web, gillnets, closed straps, fishing line, six-pack yokes, rope loops, and

gaskets/rings/bands. Plastic debris regarded as harmful to wildlife if ingested included bags, foam fragments, balloons, sheeting, and pellets. Measurements and other information on ropes, netting, and floats were recorded (see Manski et al. 1991 for data sheets).

The only special methods case was during the March 24th survey at Sandy Point where an approaching storm prevented the surveyers from finishing the transect. On that date, only 900 m of the transect was sampled and foam fragments were not collected or counted. The beach was resurveyed on April 7th and counts of foam fragments and for all debris in the last 100 m was added to the summary from March. Debris over the entire transect was counted during the April survey for comparison. Debris was collected during both surveys.

Quarterly data from the debris surveys were entered into a computerized data base for analysis and graphics production by Dr. Andrew Cole at Pennsylvania State University.

RESULTS

An average of 821 items/km (11,502 items) was recorded during 14 beach surveys in year 5. The total quantities of debris by season are presented in Table 1. Plastic constituted 95% of the total debris (Figure 2). Glass (mostly

bottles), metal (mostly cans) and paper made up the non-plastic portion of the samples. Wood was not counted and will not be considered in analysis. Glass bottles/jars tied for 10th most abundant category overall. Plastics made up over 90% of the total debris on all beaches except Cuyler Harbor which had approximately 25% non-plastic debris (Figure 3).

Miscellaneous plastic was the most common plastic debris category (50%), followed by packaging (35%), fishing (9%) and personal items (6%) (Figure 4). This breakdown is very similar to last year's. The ranking of these four categories did change seasonally, most notably in the fall sample when packaging surpassed the miscellaneous category with over 50% of the total debris (Figure 5). Fishing gear was most abundant in the summer survey. The miscellaneous category was dominated by foam and hard plastic fragments which were the two most abundant plastic items.

Collectively, the 10 most abundant plastic items (Figure 6) accounted for 82% of all the debris found. Foam and hard plastic fragments comprised 54% of the top ten items, about the same as last year's composition. Foam fragments averaged 251 per km, accounting for 31% of the total debris items. This is a decline from 35% and 55% of the debris in years 4 and 3, respectively. Sandy Point had the most foam fragments. The winter (March) survey of Sandy Point had the single greatest total of foam fragments at 1872 pieces on the 1 km

transect. Hard plastic fragments, small bottles, caps and lids, straws, small bags, oil containers, plastic food containers, toys, and rope fragments round out the top ten most abundant plastic items for year 5. Balloons, gillnet floats, and crustacean pot floats are other items that made it into the top ten seasonally (Figure 7).

Ingestible debris was dominated by foam fragments (Table 2). Small plastic bags, balloons, and small plastic sheets were other ingestible items that were abundant. Amounts were similar to year 4.

Entangling debris (Table 3) was present at a mean of 15.1 items per km, no change from year 4. Rope was the most common item, with a slight increase this year. Most of the increase in the amount of rope appears to come from Sandy Point. While the number of gaskets/rings dropped this year, the number of rope loops increased from 1 to 3.2 in year 5. Most of the closed straps came from the Arlington Beach summer (September) survey. The closed straps generally encountered were strips cut from innertubes which are used as spring closures on crab and lobster traps. No entangeled animals were found.

Though medical industry items roses to 0.9/km, nearly all items were medicine bottles. Only one syringe (insulin type) was found.

Unusual debris items included glass ball floats ranging from 35-110 mm in diameter, a toner cartridge, numerous flower

pots, and a lawn chair. Identifiable items included a korean soap dish, a cream container and shampoo bottle from Germany, two Japanese water bottles, a deodorant container made in the Philippines, a Mexican milk bottle, a shampoo bottle from the Caribbean Cruise line, and a box of military parts. Oil industry related items found included several hard hats, a pipe thread protector, and write ring protectors.

Tar or oil was found on all surveys. There are numerous natural oils seeps in the Santa Barbara Channel area and the beach tar is likely from natural sources.

Table 1. Total quantities of marine debris at Channel Islands National Park in Year 4. Totals are from all six beaches. Values from Arlington Canyon were extrapolated to 1 km, and the winter sample from Sandy Point was extrapolated from subsamples.

DEBRIS ITEM	MEAN NUMBER OF DEBRIS ITEMS PER KM
FISHING GEAR	
TOTAL	60.8
Trawl Net	0.2
Monofilament Gillnet	0.1
Multifilament Gillnet	0.1
Rope >=1 m	6.1
Rope < 1 m	13.1
Mono Fishing Line	0.1
Rope Loops	3.2
Open Straps	5.4
Closed Straps	1.6
Trawl Float	2.6
Gillnet Float	11.4
Crustacean Float	9.4
Buoy Bag	0.4
Other Float	6.5
Oil Container	17.0
Fish Basket	0.3
Bait Containers	2.6
Lures	0.5
Chemical Ampules	0
Light Stick	0.5
Fragments	0.9
Miscellaneous	1.9
PERSONAL EFFECTS (PLASTIC)	
TOTAL	46.4
Hats/Helmets	0.3
Footwear	4.1
Gloves	0.7
Smoking Accessory	6.3
Toys	13.6
Balloons	11.7
Comb/Brush/Eyeglass	1.7
Tampon Applicators	1.2
Cotton Swabs	1.6
Condom	0
Syringe	0.1
Crack Vial	0

Miscellaneous	5.1

Table 1. (Continued)

DEBRIS ITEM	MEAN NUMBER OF DEBRIS ITEMS PER KM
PLASTIC PACKAGING	
TOTAL	270.6
Bottles <= 1 Gal.	84.3
Caps/Lids	76.2
Bags < 1 m	33.8
Bags >= 1 m	0.2
Cups	2.4
Styrofoam Cups	1.7
Styrofoam Food Container	0.8
Container/Bowl/Utensil	14.4
Drinking Straws	50.4
Pails/Buckets	1.4
Six-Pack Yokes	1.1
Beverage Crates	0.1
Bulk Liquid Container	0.5
Styrofoam Packaging	0.4
Miscellaneous	2.9
MISCELLANEOUS PLASTICS	
TOTAL	382.7
Sheet < 1 m	11.2
Sheet >= 1 m	0.2
Shotgun Wads	2.8
Pipe/Tubing	2.1
Brushes/Brooms	0.3
Garbage Cans	0.1
Tires/Innertubes	0.1
Hard Fragments	108.6
Foam Fragments	250.7
Pellets	0
Gaskets/Rings	2.6
Miscellaneous	2.1
Medical	0.9
Pipe-thread protectors	0.1
Hardhats	0.5
Write protection rings	0.1

Table 1. (Continued)

DEBRIS ITEM	MEAN NUMBER OF DEBRIS ITEMS PER KM
NON PLASTICS	
TOTAL	36.4
Glass Bottles	13.1
Light Bulbs	4.1
Medical (glass)	0.1
Glass Pieces	0
Misc. (glass)	0.4
Paper	5.6
Bottle Caps	0.1
Propane Canisters	0.6
55-Gallon Drums	0.1
Beverage Cans	5.0
Other Cans	4.6
Wire/Cable	0.2
Crab/Fish Traps	0.2
Metal Pieces	0.9
Misc. (metal)	1.4
Cloth	0.4
Leather	0
GRAND TOTAL	820.5

Table 2. Types and quantities of ingestible plastic items per km at Channel Islands National Park, Year 5.

Debris item	Mean #/km	Range
Foam fragments	250.7	7-1872
Bags < 1 m^2	33.8	6-128
Balloons	11.7	1-26
Plastic sheet < 1 m^2	11.2	0-44
Plastic sheet ≥ 1 m^2	0.2	0-2
Bags ≥ 1 m^2	0.2	0-1
Pellets	0	

Table 3. Types and quantities of entangling plastic debris per km at Channel Islands National Park, Year 5.

Debris Item	Mean #/km	Range
Rope ≥ 1 m	6.1	0-15
Gaskets/rings	2.6	0-14
Six-pack yokes	1.1	0-8
Rope loops	3.2	0-13
Closed straps	1.6	0-28
Mono. fishing line	0.1	0-15
Trawl net	0.2	0-2
Mono. gill net	0.1	0-1

Multi. gill net	0.1	0-1

DISCUSSION

The results over the last four years indicate a downward trend in the amount of debris on the beaches. The average number of debris items per km in year 5 (821) was slightly less than year 4 (839) and substantially less than years 3 (1013) and 2 (1043). Plastics comprise the vast majority of debris on the beaches of San Miguel and Santa Rosa Islands. Foam fragments continue to outnumber all other debris items, though in the last two years of the study, foam fragments comprised less than half of the total debris.

Foam fragments appear to originate form many sources. Styrofoam cups and food containers (galley waste) that breakup on the beaches are probably the largest single source. Packing material, foam "peanuts", and fragmented foam insulation also contribute to the foam fragment problem. Hard fragments also come from a variety of sources and often result from plastics becoming brittle in the sun.

During December 1992, southern California experienced heavy storms. In February, torrential rains caused flooding in many of the coastal streams. Large amounts of debris were deposited on coastal beaches as noted in news articles (see appendix). Large quantities of cane (arundo grass) which does not grow on the islands, were deposited on both mainland and island beaches. This was the second year in a row for this to happen. The presence of cane on the island beaches would seem to confirm that debris from mainland sources does get

deposited on the islands. By the time the March/April surveys were conducted, the beaches had been reworked by storm waves and much of the cane had been removed. During the March/April surveys, at least six glass fishing floats ranging from approximately 35 to 110 mm in diameter were found on the beaches. This was more than we found in all the previous surveys and would seem to indicate some unusual current patterns.

Despite the high amount of debris that originated from the mainland, there was relatively little evidence of sewage associated waste, and it could just as well have originated from offshore vessels. Cotton swabs and tampon applicators are considered indicators of sewage and each averaged just over one per transect.

The commercial and recreational fishery around the Channel Islands was another source of debris worth mention. Nearly 10 percent of the plastic debris, 61 items/km, was attributable directly to fishing or boating. Rope and rope fragments were the most commonly encountered items. Nets or netting fragments were rarely encountered. Floats were common and many had long pieces of rope attached which creates an entanglement hazard. Other items such as dive gear and metal traps (and many of the pieces) may also relate to the fishing industry. Some items considered galley waste (plastic bottles, bags, glass bottles, food containers) likely emanated from fishing or pleasure vessels at the islands. Oil

containers (the 7th most abundant item) are also associated with the boating activities around the islands. Carelessness could contribute to accidental litter from blowing winds.

Overall, there was a decline in the amount of ingestible debris from years past because of the decline in the amount of foam fragments. All categories either remained the same this year or declined slightly. The number of small plastic bags remained at the same level as last year after doubling over the previous two years. Though sea turtles are rare around the Channel Islands, there are other animals such as molas and birds that may potentially ingest plastic, taking it for a food item. Sea urchins have been observed on many occasions feeding on plastic bags. The effects on the invertebrates are unknown.

Entangling debris items remained at the same level as last year (15 items/km). Rope was more abundant this year and the total length of rope collected was estimated at over 1,000 m. Considerably more rope was attached to buoys and therefore not counted. Nearly all the rope was poly line 8-20 mm in diameter. Many of the pieces were three meters or less in length though pieces 25-30 m were common.

This year, only 8 hagfish trap cones were found on survey beaches, a decline from 11, 34, and 89 in the previous three years. The pieces found were generally just the black plastic cone used at the mouth of the trap. This fishery is completely market driven with the hagfish being exported to

South Korea for eelskin leather production. The hagfish fishery in southern California ended after only one year of explosive growth in 1990. Weather conditions are likely to be a factor in the distribution of debris. Major storms can potentially act as both sources and sinks of accumulated debris on the beaches. As there are relatively few visitors on the beaches of the Channel Islands, debris originating from the islands is most likely non-existent. Large storms, especially with heavy rains, wash a large amount of debris from urban streams and sewer drains into the coastal ocean. Currents carry the debris to the islands where it can accumulate on the beaches. High winds may blow more debris onto the island beaches, but large swells may act to erode the beach and thus resuspend accumulated debris before surveys. Winds may also blow lightweight debris off the beach or bury items under drifting sand.

As mentioned in the methods section two surveys were conducted on Sandy Point in March and April. The two surveys were very close in total numbers. Discounting foam fragments, the 900 m March transc=ect had 922 items vs. the 1,146 in April. Foam frgments were over half of the total for the April survey (1,654 foam fragments). Many items were significantly less on the April survey, though small items such as caps/lids, straws, and plastic fragments increased. It is these small items that are picked up with increased serach effort. Sandy Point has the highest mean accumulation

rate (figure 8) and the highest variability among the six beaches.

OPERATIONAL SUPPORT

Volunteers contributed 44% of the total field time necessary to collect and record debris at CHIS in year 5. Volunteers included Fish and Game Biologists helping with intertidal surveys. Staff from several divisions participated in the surveys.

Marine debris surveys were combined with rocky intertidal monitoring surveys at Santa Rosa Island in April and at San Miguel Island in November and April. This saved money for transportation and made the most efficient use of time.

In addition to funds from the National Park Marine Debris Monitoring Program, approximately $4,100 from park base operating accounts for permanent and seasonal staff time supported the surveys in year 5.

Several evening interpretive talks were given at the park during the year. The Park participated in the annual Coastal Cleanup by coordinating cleanup of the mainland beaches in front of the visitor center. The Park also supported several volunteer trips coordinated by the Friends of Channel Islands National Park to clean beaches at Anacapa and Santa Cruz Islands.

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FIGURES